JPRS 75506

16 April 1980

USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 60

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semimonthly by the NTIS, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available through Bell & Howell, Old Mansfield Road, Wooster, Ohio, 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

Soviet books and journal articles displaying a copyright notice are reproduced and sold by NTIS with permission of the copyright agency of the Soviet Union. Permission for further reproduction must be obtained from copyright owner.

JPRS 75506

16 April 1980

USSR REPORT

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 60

This serial publication contains articles, abstracts of articles and news items from USSR scientific and technical journals on the specific subjects reflected in the table of contents.

Photoduplications of foreign-language sources may be obtained from the **Photoduplication** Service, Library of Congress, Washington, D.C. 20540. **Requests** should provide adequate identification both as to the source and the **individual** article(s) desired.

CONTENTS PAGE

CERTAIN ASPECTS OF COMPUTERS, CONTROL, AUTOMATION TELEMECHANICS AND MACHINE PLANNING 1

Mathematical Modeling of a Ferrite Core Memory 1

COMMUNICATIONS, COMMUNICATION EQUIPMENT, NETWORKS, RADIOPHYSICS, DATA TRANSMISSION AND PROCESSING 2

Electrical Parameters of Metal Sheaths of Communications Cables With Industrial Frequency Alternating Current..... 2

COMPONENTS AND CIRCUIT ELEMENTS, INCLUDING WAVEGUIDES, CAVITY RESONATORS AND FILTERS 4

The Charge in a Capacitance Bank of Constant Power 4

Inductive Charging of a Fluid in the Electric Field of a Cylindrical Capacitor 4

Improvement of Characteristics of Selectors of Pulses of Specific Length 5

Aspects of Algorithms for Digital Filtering in Real Time... 6

CONTENTS (Continued) Page

CONFERENCES, SEMINARS, EXHIBITIONS, SYMPOSIUMS 8

International Exhibition "Electrotechnology 80"--Path to Improvement of Production 8

All-Union Scientific-Technical Conference on the Use of High-Voltage and Low-Voltage Electrical Equipment at Altitudes Higher Than 1000 m Above Sea Level............... 8

CONVERTERS, INVERTERS, TRANSDUCERS 10

Utilization of Time Scale Compression in Voltage-Time Interval Integrating Converters 10

CYROGENICS AND SUPERCONDUCTIVITY 11

Magnetic Field in a Cryotron With an External Shield 11

Analysis of the Increase in Hysteresis Losses in a Coaxial Superconductive Cable With Misalignment of Current-Carrying Cores.. 12

ELECTRICAL ENGINEERING EQUIPMENT AND MACHINERY 13

Force Effect of a Pulsed Magnetic Field on a Conducting Half-Space Through a Shield 13

Inductive Accumulator With Electromagnetic Current Multiplication 14

Investigation of a Superhigh-Power Two-Machine Unit With Cascade Starting of the Main Motor 15

Linearization of Digital and Digital-Analog Automatic Systems 16

Designing Magnetic Shields of Complicated Shape 17

Calculating Inductors for Heating Ferromagnetic Cylindrical Bodies.. 17

A Linear Induction Micromotor With Nonmagnetic Secondary Element 18

Influence of the Fluid Dielectric on Magnetic Vibration of an Immersible Motor 18

CONTENTS (Continued) Page

Equations of the Dynamics of a Magnetoresonant Suspension in the Working Field of an Electric Motor 19

Influence of Load on the Precision of a Four-Winding Linear Rotary Transformer 20

Thermal Conditions of High-Voltage Transformer Thyristors With Evaporative Cooling.............................. 21

Analysis of Postcommutation Processes in a High-Power High Voltage Semi-Conductor Transformer 22

Characteristics of the Break Arc in Gas Circuit Breakers... 23

GENERAL CIRCUIT THEORY AND INFORMATION 25

Precision of Inductive Angle Measuring Element in a Double Voltage Conversion Circuit 25

Aspects of the Excitation of Subharmonic Oscillations in Multiloop Alternating Current Ferroresonant Circuits..... 25

GENERAL PRODUCTION TECHNOLOGY..................................... 27

Electrical Drives: Present Status and Future Outlook 27

Developing Standard Series of Electrical Machines-Technical Policy of the Electrical Engineering Industry in the Soviet Union 28

Achievements and Main Development Trends in the Cable Industry.. 29

Tasks in the Further Development of Low-Voltage Equipment Manufacture 30

Manufacture of Power Semiconductor Devices 31

Investigation of the Magnetic Properties of Fe-Si-Al Alloys in the High-Frequency Region............................ 31

INSTRUMENTS, MEASURING DEVICES AND TESTERS; METHODS OF MEASURING.. 33

Functional Display for Representation of a Three-Dimensional Picture of Oil Wells....................... 33

CONTENTS (Continued) Page

OPTOELECTRONICS, QUASI-OPTICAL DEVICES 35

Influence of Nonuniformity of the Source's Brightness on the Position of the Optical Equal-Signal Zone........... 35

OSCILLATORS, MODULATORS, GENERATORS.............................. 37

Square Voltage Pulse Generator 37

POWER SYSTEMS [INCLUDING EFFECT OF VARIOUS ITEMS ON POWER TRANSMISSION LINES].. 38

Screening Effect of Conductor Sheaths Connected Electrically to a Conducting Casing 38

Operating Experience With Standard Electrical Equipment in the Armenian Main Power Supply System Under High-Altitude Mountainous Conditions 38

Investigation of Transient Processes in Guaranteed-Power-Supply Systems 39

On the Probability and Statistical Characteristics for Short Circuit Currents in Power Supply Systems 40

Development of Dischargers for Operation in High-Mountain Regions 41

Switching Overvoltages When Switching Off Large Capacitor Banks With Protective Devices 42

PULSE TECHNIQUES 44

Interaction of a Magnetic Pulse Field With a "Half Space" Moving at Constant Velocity 44

SYSTEMS ANALYSIS 45

Methodological Aspects of Determining the Demand for Electrical Equipment Production 45

Certain Aspects of Computers, Control, Automation Telemechanics and Machine Planning

USSR UDC 681.3

MATHEMATICAL MODELING OF A FERRITE CORE MEMORY

Leningrad IZVIVUZ: PRIBOROSTROYENIYE in Russian Vol 22 No 9, Sep 79 pp 45-48 manuscript received 22 Mar 79

VLASOV, V.A., KONSTANTINOVSKIY, V.M. and SHAMAYEV, YU.M., Moscow Power Engineering Institute

[Abstract] A mathematical model is presented of a ferrite core memory, based on a mathematical model of the ferrite core itself, improved and refined for the purpose of modeling trensient processes in a memory. Because the processes in the lines of the memory are identical, in modeling an analysis is made of transient processes in a memory in a crisscross arrangement including a single register line and a single address line, taking into account the influence of the remaining lines. An equivalent circuit is presented for the lines of a core memory. This circuit includes the resistance of the wires of the grid, computed by taking into account the surface effect resulting from the fact that currents in the lines are of a pulsed nature; the induction of a grid line, computed as the sum of the intrinsic induction of the line and the mutual induction of the wires connected to it; and the capacitance of a line, computed as the sum of the capacitance of the line itself in relation to the substrate, the capacitance in relation to the nearlying wires, and the capacitance of cross wires. Processes in a ferrite core memory are modeled by taking into account the prehistory of the cores. Ferrite cores in a memory can be in four ground states; these states are determined from a mathematical model of a ferrite core under the effect of a series of pulses on the core. This model takes into account the fact that real memories operate in particular symmetric or asymmetric cycles. Equations are written for circuit loops, taking into account the magnetic prehistory of the cores. The system of differential equations derived is solved by means of a standard subprogram on a BESM-6 computer, employing the Runge-Kutta method. Results are given of modeling of the transient process in a ferrite core memory with a capacity of 512 X 64 bits, along with experimental results. The mathematical model presented makes it possible to analyze the influence of a change of load on transient processes in the circuit; to analyze the influence of different types of core designs on processes in the memory, such as operating speed and signal-to-noise ratio; to calculate the signal-to-noise ratio in a register line for different operating modes; and to calculate the range of the memory's working capacity on the basis of an analysis of transient processes in it. This is possible by adding to the model differences in core parameters and design parameters of the memory and changes in the voltage of power supplies and in the temperature of the environment. The paper was recommended by the Department (Kafedra) of Computing Techniques. Figures 3; references: 3 Russian.
[103-8831]

Communications, Communication Equipment, Networks, Radiophysics, Data Transmission and Processing

USSR UDC [621.315:621.395.741].001.24

ELECTRICAL PARAMETERS OF METAL SHEATHS OF COMMUNICATIONS CABLES WITH INDUSTRIAL FREQUENCY ALTERNATING CURRENT

Moscow ELEKTRICHESTVO in Russian No 11, 1979 pp 72-74 manuscript received 11 Apr 79

SUMIN, A.R., candidate in technical sciences, Omsk

[Abstract] The fact that the longitudinal resistance of communications cable sheaths depends nonlinearly on the value of the current flowing through them makes it difficult to make a theoretical determination of the impedance, effective resistance and inductive reactance of metal communications cable sheaths with 50 Hz alternating current. It is necessary to know the grade of steel of the armoring tape and to have a magnetization curve for the steel armor. Curves illustrating the dependence of the magnetic permeability of steel tape on current density are not universally available. The intrinsic induction of armoring tape can be calculated only with a known value of the current in the cable's sheath, because it characterizes the strength of the magnetic field in the cable's armor and therefore the relative magnetic permeability of the armoring tape. The complexity, approximate nature, and labor intensiveness of calculating impedance have made it necessary to make a special experimental study of the electrical parameters of metal sheaths for communications cables over a wide range of variation of the alternating current. A description is given here of a measuring system in which the electromagnetic influence of the current in the sample of cable on the measuring equipment is insignificant. The voltage drop and current in the metal sheathing were measured by a type F506 voltmeter and an AST ammeter. The active power was measured with a type D542 wattmeter. The wattmeter was connected across UTT-5 current transformers and an NTMI-10-66 stepup voltage transformer with a transformation ratio of 1000/100. This system made it possible to determine the effective resistance of metal sheaths in the low-current range of 5.0 to 15 A. The voltage range of the wattmeter was increased to measure higher currents. An experimental study was made of electrical parameters in samples of communications cables of different brands five to six m long. The armor consisted of magnetic sheet steel and round or oval galvanized steel wire. A table is given of measured electrical parameters of metal sheaths for communications cable for 50 Hz alternating current. It is demonstrated that if the armor is made of steel with low magnetic permeability, such as galvanized flat or oval wire, the effective resistance and impedance of the protective sheath depend relatively little on the current passing through. The problem is discussed of a metal protective sheath consisting of two or three coaxial cylindrical conductors. This arrangement represents a complex system with different electrical and magnetic properties: When alternating current is passed through the system's elements the equivalent effective resistance of the sheath increases drastically because of the surface effect in the steel armor and the effect of the proximity of coaxial conductors. The data in the table presented make it possible to simplify the complicated and labor intensive procedure of computing the longitudinal resistance of a communications cable metal sheath with alternating current. The cross inductive reactance between the sheath and the cable's core predetermines the compensating effect of the induced or back current flowing through the metal sheath of the cable. It is shown that the absolute value of this cross inductive reactance is determined by both the magnetic properties of the material of the armoring tape and the impedence of the metal sheath to alternating current and depends relatively little on the current passing directly through the armoring tape. Characteristic of cables with an aluminum sheath is the fact that this cross inductive reactance is commensurate with the longitudinal impedance of metal sheaths to 50 Hz alternating current. The experimental studies described here cover practically all brands of communications cable laid in alternating current electrified railroads. Figures 1; tables 2; references 7: 6 Russian; 1 Western. [91-8831]

USSR UDC 537.22.011.5

THE CHARGE IN A CAPACITANCE BANK OF CONSTANT POWER

Moscow ELEKTRICHESTVO, No 1, Jan 80, pp 50-52 manuscript received 11 Dec 78

KOFMAN, D.B., Moscow

[Abstract] The principles of control of voltage and current and the indices of the charge process in a regime of consumption of constant power are determined, with the effective resistance of a noninductive charge circuit taken into account, which assures a charge of the capacitive bank with a steady consumption of power. It is shown that with supply from sources of commensurate power, charge devices with a steady consumption have the best energy characteristics, particularly with $\tau < 0.4$. The amplitude of the utilized current of controlled devices with uniform consumption is below the corresponding value of the current of charge devices operating in a regime of maximum efficiency. Figures 4; tables 1; references: 3 Russian.
[125-6415]

USSR UDC 621.319.48.001.24

INDUCTIVE CHARGING OF A FLUID IN THE ELECTRIC FIELD OF A CYLINDRICAL CAPACITOR

Moscow ELEKTRICHESTVO, No 1, Jan 80, pp 53-55 manuscript received 28 Dec 78

BUREYEV, T.K. and STANOV, V.M. Gorskiy [Gor'kiy ?] Agricultural Institute.

[Abstract] The paper considers the process of charging a fluid in a constant electrical field of a cylindrical capacitor without taking into account the edge effect. It is assumed that the fluid has a relative dielectric constant ε and an electrical conductivity γ. Between the surface of the fluid and the exterior electrode, a medium is found with a relative dielectric constant ε_2 and an electrical conductivity γ_2. The effect is determined of the physics of the process, the influence of the technological parameters, and the properties of the material and the medium on the degree of charging of the fluid. An evaluation is made of the limiting parameters of the electrical field during charging of the liquid. Figures 3.
[125-6415]

USSR UDC 621.344

IMPROVEMENT OF CHARACTERISTICS OF SELECTORS OF PULSES OF SPECIFIC LENGTH

Leningrad IZVIVUZ: PRIBOROSTROYENIYE in Russian Vol 22 No 9, Sep 79 pp 13-17 manuscript received 20 Jan 78

ALIYEV, T.M., DZHAGUPOV, R.G., VAYSMAN, G.S. and MAMEDOV, R.K., Azerbaydzhan Institute of Petroleum and Chemistry imeni M. Azizbekov

[Abstract] A description is given and an analysis is made of a pulse selector which has been developed which makes it possible to select pulses by their length with a minimum length of 0.3 us. This selector has been used in visual data identification systems employing television readers for finding classification traits of images. The selector's circuitry includes a delay element and to it has been added a circuit for resetting the reference delay interval upon termination of the pulse interrogated. The delay element is a multivibrator assembled from logic elements. The selector contains circuits for forming signals for termination of the interrogated pulse and a reference delay interval. The output of the reset signal shaper and the multivibrator's feedback loop are united by an exclusive OR gate. The selection signal is formed by a coincidence circuit. The selector's input contains a matching inverter. The multivibrator is triggered by the leading edge of each pulse of the incoming train. When the length of the incoming pulse equals the length set in the input of the coincidence circuit, signals for termination of the interrogated pulse and the reference delay interval act simultaneously, and a selection signal appears in the selector's output. The signal for resetting the delay which is supplied to one of the inputs of the exclusive OR gate after shaping of the interrogated pulse does not alter the state of the multivibrator, which has already gone into a state of rest. A selection signal is not formed when the length of the incoming pulse differs from that which has been set. When the length of the interrogated pulse is less than that set, the delay reset signal forces the multivibrator into a state of rest. As a result, the reference delay interval is incompletely formed in the selector and the selector is ready to interrogate the next pulse. Calculation equations are given for the selector. A theoretical analysis demonstrates that the hysteresis period for this selector lies in the range of 0.3 to 1.1 us when employing series 155 logic elements with approximately 0.07 us gating and a present pulse length range of 1 to 10 us. When the length of the interrogated pulses is longer than that preset, the hysteresis period is reduced to 0.1 to 0.15 us. Experiments have demonstrated that the operating stability of this selector is sufficiently high. Figures 1; references: 4 Russian.
[103-8831]

USSR UDC 621.372.542.3

ASPECTS OF ALGORITHMS FOR DIGITAL FILTERING IN REAL TIME

Leningrad IZVIVUZ: PRIBOROSTROYENIYE in Russian Vol 22 No 9, Sep 79 pp 8-13
manuscript received 21 Nov 78

NIKOLAYEVA, N.D. and AL'TSHULLER, V.N., Leningrad Mechanics Institute

[Abstract] Aspects are discussed of the application of the chief methods of digitization in the design of a digital low-frequency filter having a Butterworth low-frequency filter as an analog prototye. In employing an analog prototype the object is to design a filter which will provide high filtering accuracy while operating in real time and will make possible the lowest number of arithmetic operations and memory elements. Two methods of digitization are employed, one based on the z-transform theory and the other on employing methods of numerical integration. Equations are given for the square of the absolute value of the frequency characteristic (1) and for the transfer function (2) of a continuous Butterworth low-frequency filter for even orders of magnitude. Specific methods of digitization are discussed, based on the two above-named major methods. Those based on the z-transform method include a method based on the employment of a bilinear z-transform for the digitization of equation (1) with its subsequent factorization; the Tastin method, based on applying a bilinear z-transform to equation (2); and the Boxer-Taler method, based on using z-forms for the purpose of digitizing equation (2). Of the group of methods employing numerical integration is discussed the method employed in the state space theory, in which a vector matrix form of the prototype filter is used. By using the computing procedures of the first three methods, three variants of discrete transfer functions for a digital Butterworth low-frequency filter are arrived at, which differ in structure or coefficients. The expressions for these discrete transfer functions and equations for coefficients are given in a table. For each of these three methods of digitization are indicated the discrete transfer function of the digital filter, equations for the digital filter's system function coefficients, recursion equations for a single section of the digital filter's system function, and the number of multiplication operations in the computation cycle. The cascade method is employed to program the discrete transfer functions arrived at. The filtering algorithms are in the form of systems of n/2 recursion equations, where n is the order of the filter. The data in the table demonstrate that the Tastin and Boxer-Taler methods result in a discrete transfer function with an identical structure, and the respective algorithms have an identical number of multiplication operations, and the algorithm obtained by programing the discrete transfer function arrived at by the Tastin method contains the lowest number of multiplication operations, 3n/2, and thus provides the fastest computing speed. Discussed is the method of facilitating realization in real time by

employing in the algorithm only the previous values of the variables entering into it for the purpose of computing the instantaneous value of the output signal. The general method of digitization employing methods of numerical integration is discussed, in which a discrete system arrived at directly in the form of a vector matrix recursion equation is realized. Methods are discussed of realizing a computing cycle which will contain the minimum possible number of multiplication operations, 2n, for the discrete transfer function programmed. A system of recursion equations is arrived at which describes a digital low-frequency filter which requires the least number of multiplication operations in the computing cycle with facilitated conditions for realization of this cycle in real time. An evaluation is made of the filtering quality of the digital Butterworth low-frequency filters arrived at. Filtering quality is evaluated in terms of the closeness of the logarithmic amplitude characteristic to the square characteristic of an ideal Butterworth low-frequency filter. It is demonstrated that the algorithms arrived at make possible good filtering quality and high filtering speed in real time. The paper was recommended by the Department (Kafedra) of Computing Techniques. Figures 1; tables 1; references: 3 Russian.
[103-8831]

USSR

INTERNATIONAL EXHIBITION "ELECTROTECHNOLOGY 80" -- PATH TO IMPROVEMENT OF PRODUCTION

Mowcow ELEEKTRICHESTVO, No 1, Jan 80, pp 75-76

GRISHIN, V.F. and SOKOLOVSKIY, S.M.

[Abstract] The USSR Chamber of Commerce and Industry in accordance with a suggestion of the Ministry of the Electrical Equipment Industry will hold in Moscow from 15 to 24 October 1980 a specialized exhibition "Technological Equipment for Production of Electrical Engineering Items" -- "Electrotechnology 80." It is proposed that several hundred firms will take part in this exhibition, and symposiums will be conducted. Tasks of the exhibition include: Presentation of the newest achievements in the field of production of machines, equipment, devices, materials, and other production conforming to the subject matter of the exhibition; exchange of scientific-technical experiences; cooperation by representatives of Soviet and foreign business circles in the establishment of contacts and the expansion of trade, economic and scientific-technical ties. It is hoped that among the exhibitors will be the largest electrical engineering firms and concerns of the world. Technological equipment from almost all directions of electrical engineering will be shown. The various types of items to be exhibited are listed.
[125-6415]

USSR

ALL-UNION SCIENTIFIC-TECHNICAL CONFERENCE ON THE USE OF HIGH-VOLTAGE AND LOW-VOLTAGE ELECTRICAL EQUIPMENT AT ALTITUDES HIGHER THAN 1000 m ABOVE SEA LEVEL

Moscow ELEKTROTEKHNIKA in Russian, No 1, Jan 80 p 53

Editorial staff

[Abstract] Under the sponsorship of the USSR Ministry of the Electrical Equipment Industry, a conference on the use of high-voltage and low-voltage equipment in mountainous regions at altitudes higher than 1000 m, up to 5000 m above sea level, was held in Yerevan on 12-14 September 1978. Thirteen reports were presented and discussed which dealt with the properties and the performance of insulation materials in an environment characterized by low-pressure levels and wide temperature swings, as well as with the design of protective devices for high-voltage transmission networks and low-voltage

power equipment under these conditions. The participants agreed on the need to study further the requirements for the 1980-90 period in terms of high-altitude 0.23-500 kV equipment, to continue scientific research and experimental engineering efforts in the areas of high-voltage high-altitude classes of equipment for power networks and industry located in mountainous regions, to develop a comprehensive testing program and to modernize existing test equipment, to organize processing and analysis of high-altitude data, to consider equipment standardization within the feasibility limit, to modify and adapt existing 35-110 kV equipment, and specificallv to consider the use of highly nonlinear resistors for overvoltage limiters.
[148-2415]

Converters, Inverters, Transducers

USSR UDC 621.317.725

UTILIZATION OF TIME SCALE COMPRESSION IN VOLTAGE - TIME INTERVAL INTEGRATING CONVERTERS

Leningrad IZVIVUZ: PRIBOROSTROYENIYE in Russian Vol 22 No 9, Sep 79 pp 3-8
manuscript received 8 Sep 78

ZHURIN, A.A., Penza Polytechnical Institute

[Abstract] A method is discussed of designing integrating-voltage-to-time-interval converters which employ intermediate time scale conversion. This method is a variation of the classical approach of matching the frequency range of the signal under study with the frequency range of the measuring equipment, i.e., the employment of devices which speed up the signal (time compression devices) for studying "slow" signals, and devices which slow down the signal (time expansion devices) for "fast" signals. In the method discussed, the integral value of the quantity to be converted is subjected to time compression. The employment of this method eliminates the need for switching elements in the signal-conversion circuit and the disadvantages that their presence entails, and also overcomes the slow speed of response characteristic of integrating converters of the quasi-scanning type. The converter consists of a time-scale converter and a voltage-to-time-interval converter with push-pull integration. The time-scale converter consists of an integrator based on a d.c. differential amplifier, a non-inverting clipper amplifier and a switch. The operation of the time-scale converter is broken down into three stages, which are discussed in detail in terms of the state of the switch. The conversion process is performed essentially as follows: At the output of the time-scale converter a voltage, U_p is formed, whose integral value during the period to time T_p equals the integral value of the input voltage, U_x, during the period ot time T. Simultaneously with the formation of voltage U_p, it is integrated by means of the voltage-to-time-interval converter during the period to time T_p. Then the reference voltage, U_0, is integrated until its integral value equals the integral value of voltage U_p, bearing information on the mean value of voltage U_x during the period of time T. Time interval T_x, during which reference voltage U_0 is integrated, is proportional to the mean value of U_x during the period of time T. With a recovery error of 0.001, the recovery time with a clipper amplifier gain of 10^3 equals about 100 us. The parameters of the switch in the time-scale converter show practically no influence on the total error in view of the high value of the clipper amplifier's gain. The time-scale converter is a closed control system with the switch in the forward circuit, which also explains this fact. The unit is constructed from series 153 and 143 microcircuits and type S5-5 resistors. By a theoretical and experimental analysis it has been determined that with the clipper amplifier's gain equal to 10,000 the converter's principal error is not greater than 0.01 percent. The paper was recommended by the Department (Kafedra) of Information-Measuring Techniques. Figures 3; references: 6 Russian.
[103-8831]

USSR UDC 621.59:621.314.6.013.001.24

MAGNETIC FIELD IN A CRYOTRON WITH AN EXTERNAL SHIELD

Moscow ELEKTRICHESTVO in Russian No 11, 1979 pp 58-61 manuscript received 20 Mar 78

DRONOV, A.S., LUTIDZE, SH.I. and NAROVLYANSKIY, V.G., Institute of Power Engineering imeni G.M. Krzhizhanovskiy

[Abstract] General questions are discussed relating to the calculation of the electromagnetic characteristics of cryotrons with a shield in which the gate is placed in the space between the control coil and an external closed superconducting shield in the form of a hollow cylinder. A method is suggested for calculating the current density distribution in the shield and the resulting magnetic field in the gap between the control coil and the external closed superconducting shield. This method makes it possible with a degree of accuracy sufficient for practical applications to select the superconducting material and the tentative dimensions of the external superconducting shield on the basis of the calculated density of the shielding current, to optimize the dimensions of the control coil and to determine its minimum operating current, to calculate the dependence of the gate's critical current on the control current, i.e., the magnetic field, and to calculate the inductance of the shielded coil and to select the required power for control for a specific speed of response. Calculated and experimental results are given for a cryotron with a working current for the gate of 1000 A. The control coil has an inside diameter of 20 mm, an outside diameter of 26 mm, a height of 30 mm, a wire diameter of 0.33 mm and 970 turns. The gate is made of lead containing 3.8 percent antimony, measures 0.03 X 25 X 450 mm, and has a resistance in the resistive state at 4.2°K of 0.8 m . The shield has a wall thickness of 0.02 mm, is 30 mm high and has an inside diameter of 33.2 mm. The calculation method employed calculates the influence of the superconducting shield on the electromagnetic characteristics of the coil on the basis of dividing the shield into a number of magnetically coupled loops with a circular cross section arranged in the surface layer of the shield and on solving a system of equations for the magnetic interrelationship between them. The boundary conditions for the magentic vector of the potential on the surface of the shield are taken into account and a calculation is made of the distribution of th density of the surface current making possible fulfillment of these conditions. The electromagnetic properties of the shielding element are conditioned by its magnetic permeability and the presence of eddy currents excited in it under the effect of the magnetic field of the control coil. The shielding element is substituted by equivalent secondary field sources, i.e., a system of magnetizing and eddy current. The eddy currents keep the magnetic flux in each section of the cylindrical shield constant over time, and the magnetizing currents prevent penetration of the magnetic current into the body of the superconducting shield, i.e., the Meisner

effect is realized. The resulting magnetic field in the gap is directed along the shield's generating lines and thus the magnetic field in the gap does not have a radial component. This makes it possible to replace a thin superconducting shield with a single equivalent system of secondary sources, i.e., a system of eddy currents. This assumption makes it possible to calculate the electromagnetic characteristics of elements and the cryotron as a whole with a degree of accuracy sufficient for engineering design. Figures 5; references 5: 3 Russian; 2 Western.
[91-8831]

USSR UDC 621.315.55:537.312.62

ANALYSIS OF THE INCREASE IN HYSTERESIS LOSSES IN A COAXIAL SUPERCONDUCTIVE CABLE WITH MISALIGNMENT OF CURRENT-CARRYING CORES

Moscow ELEKTRICHESTVO in Russian No 12, Dec 79 pp 20-23 manuscript received 23 Jun 78

SMIRNOV, S. K., KUNO, M. YA., engineers, and BENDIK, N. T., candidate in physicomathematical sciences, Moscow

[Abstract] The losses in superconducting cables are hysteresis losses in the a-c superconductor which depend on many factors. The present paper considers the influence of a geometric factor--misalignment of the current cores in a coaxial cable, i. e. one in which cylindrical conductors have parallel axes. The magnetic field in the gap of a coaxial cable is described by ordinary Maxwell equations for a nonconductive medium with constant magnetic properties. The magnetic field within the superconductor conforms to the London equation of the critical state for a type II superconductor. The depth of penetration of the field into the superconductor is much smaller than the dimensions of the conductors or the distance between them. The distribution of the magnetic field around the perimeter of a conductor is found, assuming that the perpendicular field component on the surface is zero, and the field distribution is then used to find the distribution of losses. The calculation is based on previously derived relations for the magnetic field dependence of the specific losses on a unit area of the flat surface of a superconductor: $W \sim H^p$, where W is in W/m^2, and p is taken as ranging from 3 to 4 for niobium and Nb_3Sn. It is found that if the permissible loss increase in the inner conductor is limited to 10 percent, the range of deviation from the coaxial position is $s/(r_2 - r_1) < 0.29$ when $r_1/r_2 = 0.8$ if $p = 3$, and $s/(r_2 - r_1) < 0.2$ when $r_1/r_2 = 0.8$ if $p = 4$, where s is the distance between the axes of the inner and outer conductors, r_1 is the outside radius of the inner conductor, and r_2 is the inside radius of the outer conductor. Figures 1; references 6: 5 Russian; 1 Western.
[132-6610]

Electrical Engineering Equipment and Machinery

USSR UDC 538.311.001.24

FORCE EFFECT OF A PULSED MAGNETIC FIELD ON A CONDUCTING HALF-SPACE THROUGH A SHIELD

Moscow ELEKTRICHESTVO in Russian No 11, 1979 pp 53-55 manuscript received 26 Dec 77

BONDALETOV, V.N., ODNORAL, A.P. and CHERNOV, YE.N., Otdeleniye VEI V Istre (All-Union Order of Lenin and Order of the October Revolution Electrical Engineering Institute imeni V.I. Lenin, Istra Division)

[Abstract] The force effect of a pulsed magnetic field on a well conducting massive body through a plane shield with low conductivity can be utilized in a dynamic induction-type drive for switching equipment, with the armature placed inside and the coil outside the compartment in which the unit's contacts are installed. From the viewpoint of the investigation of electromagnetic processes these devices represent a two-layer conducting medium.
A study is made here of the dependence of the impulse transmitted through the plate on the parameters of the plate and base and also on the magnitude and frequency of the external field. A choice is made of the optimal range of variation of these magnitudes for maximum transmission of the impulse through the conducting shield. Approximation equations are given for the maximum value of the impulse acting on the plate, F_1^*, and the base, F_2^*, for the case of variation of the external field on the surface of the two-layer medium corresponding to the case of the discharge of a capacitor onto an active inductive load. A discussion is given of the influence of parameters X, n and $/w_0$ on the magnitude of impulses, their ratio (F_2^*/F_1^*), and the ratio of the impulse acting on the underlying base to the impulse acting on the conducting single-layer medium, F_2^*/F_{01}^*. Here X is a complex characterizing both the material and the thickness of the plate and the frequency of variation of the external field, n is a parameter characterizing the ratio of conductivities, and $/w_0$ is a parameter characterizing the attenuation factor of the circuit. The results are presented in graphic form. A reduction of condition X results in an increase in the impulse acting on the base and a reduction in the impulse acting on the plate. Corresponding to high values of n are low values of the impulse transmitted to the base and high values of that transmitted to the plate. With an increase in attenuation there takes place a considerable reduction in the impulse acting both on the plate and on the base. With an increase in X there is a reduction in the impulse transmitted to the base and an increase in that acting on the plate. This effect is most pronounced with low values of the attenuation factor. This study of the force effect of a pulsed magnetic field on a conducting underlying base demonstrates that for the purpose of transmitting on the order of 80 percent of the impulse through the plate it is necessary that condition X vary over the range of 0.01 to 0.02 with variation in n from 0.1 to 0.3 with attenuation of less than or equal to 0.1 or 0.15. The results are

given of calculations of X for different materials of the plate, thicknesses and frequencies. The magnitude of the impulse transmitted through the plate is determined by utilizing the equations for the impulse acting on the plate and base, their relationships to X, and the dependence of X on the frequency and thickness and material of the plate. For a plate 0.8 mm thick made of stainless steel, at a frequency of 1200 Hz through the plate is transmitted about 80 percent of the impulse. This result proves that it is possible to create a dynamic induction-type drive for gas-filled and vacuum electrical devices with an armature placed inside and the coil placed outside the chamber, utilizing the force effect of a pulsed magnetic field through a shield. Figures 3; tables 1; references: 4 Russian.

USSR UDC 538.527.001.24

INDUCTIVE ACCUMULATOR WITH ELECTROMAGNETIC CURRENT MULTIPLICATION

Moscow ELEKTRICHESTVO, No 1, Jan 80, pp 47-49 manuscript received 3 Nov 78

IVLEV, A.V., KIBARDIN, A.S., KOMIN, A.V., KUCHINSKIY, V.G., LOBANOV, K.M. and MOROZOV, YU.A. Scientific-Research Institute of Electrophysical Apparatus imeni D.V. Yefremov

[Abstract] The principles of operation of a scheme for an inductive accumulator with electromagnetic current multiplication (AECM) are considered and this type of accumulator is compared with an inductive accumulator made with mechanical current multiplication. Use of the AECM makes it possible substantially to decrease the number of elements in the switching system and to eliminate switches on the multiloop coil , but in so doing a large expenditure of metal for the conductor is required. Optimization of the geometry if the toroidal accumulator is obtained as well as an evaluating formula for the energy released into the load. Figures 3; references: 2 Russian
[125-6415]

USSR UDC 62-83.001.57

INVESTIGATION OF A SUPERHIGH-POWER TWO-MACHINE UNIT WITH CASCADE STARTING OF THE MAIN MOTOR

Moscow ELEKTRICHESTVO in Russian No 11, 1979 pp 5-11 manuscript received 14 Feb 79

SHULAKOV, N.V., candidate in technical sciences, and TREFILOV, V.A., engineer, Perm'

[Abstract] There is a worldwide trend in the metallurgical industry toward the employment of superhigh-power units with synchronous turbomotors with an output of as high as 70 MW apiece. One of the methods employed to solve the problem of starting these turbomotors has been the creation of two-machine units with cascade starting of the main motor and the use of an auxiliary asynchronous motor with a phase-wound rotor in the working mode. A study is made of transient processes both in the electromechanical stage in starting and in the two-machine unit in various operating modes when employing as the auxiliary motor series-produced asynchronous phase-wound rotors of the normal design. The particular unit studies is a two-machine unit for a K-3000 blast furnace turbocompressor, consisting of a 12.5 MW STD-12500 main motor and a 4 MW FAZ-4000 auxiliary motor. The main advantages of a cascade connection as opposed to the usual type of acceleration without an electrical connection is a shock-free startup and precise synchronization with the line of the main motor, which is carried out simultaneously with the entry of the two-machine unit into synchronism during the excitation of the auxiliary motor. There is thus no need for a special precise synchronization unit. A distinctive feature of the cascade connection is the fact that the voltage in the main motor increases smoothly from 0.1 times the nominal voltage to the nominal voltage with the electromechanical stage rotating at the synchronous speed. It is practically impossible to accomplish this with the ordinary acceleration method without an electrical connection between the motors. A theoretical study, and the results of an experimental study, are presented of the transient processes in the electromechanical stage, of the dynamic stability of a two-machine unit, and of the steady-state operating mode of a two-machine unit. Oscillograms are shown of the cascade startup of an STD-12500 turbomotor with an FAZ-4000 starting motor. Synchronization is accomplished by excitation of the starting motor with a synchronization period of 1 s. The value of the direct current in the auxiliary motor's rotor corresponding to minimum voltage in it depends both on the drag torque on the shaft and on the displacement angle. With an optimal excitation current the voltage in the auxiliary motor is practically lowered to zero and commutation takes place in it under ideal conditions. A deviation of ± 10 percent in the excitation current from the optimal value is not hazardous from the viewpoint of commutation of the auxiliary motor. It is demonstrated that lowering of the power line voltage to 0.7 times the nominal voltage,

a load pileup of 1.1 relative units and a suddenly varying load of 1.65 relative units does not result in violation of the stability of the synchronous operation of a superhigh-power two-machine unit. When the line voltage drops to 0.5 times the nominal voltage it is sufficient to force excitation of the main motor alone by a factor of 1.5. The general conclusions are drawn that the unit can be synchronized reliably by means of the excitation of an auxiliary asynchronous motor with a phase-wound rotor of the normal design, and that instead of an STD-2000 motor as the electric drive for a K-3000 turbocompressor it is advisable to use a two-machine unit consisting of an STD-12500 main motor and an FAZ-4000 auxiliary motor. Figures 5; references 5: 3 Russian; 2 Western.
[91-8831]

USSR UDC 62-83-52

LINEARIZATION OF DIGITAL AND DIGITAL-ANALOG AUTOMATIC SYSTEMS

Moscow ELEKTRICHESTVO in Russian No 12, Dec 79 pp 56-59 manuscript received 16 Mar 77

KULESSKIY, R.A., candidate in technical sciences, Sverdlovsk

[Abstract] Most industrial mechanisms with electric drives that require precision in steady-state operation use digital-analog control systems that combine the positive aspects of discrete and continuous control methods. The influence of level quantization in the process of stabilization of velocity is considerable over a wide velocity range (1:1000). The author shows how the influence of this quantization can be reduced by linearization. The linearized system is stable for any perturbations. It is found that linearization improves the dynamic and static characteristics of the electric drive system, minimizing the influence of processes of quantization by level. When play is present in the gear drive, linearization provides additional improvement in the dynamic properties of the system. Figures 4, references: 5 Russian.
[132-6610]

USSR UDC 621.3.013.001.24

DESIGNING MAGNETIC SHIELDS OF COMPLICATED SHAPE

Moscow ELEKTRICHESTVO in Russian No 12, Dec 79 pp 28-32 manuscript received 13 Oct 78

STEBLEV, YU. I., candidate in technical sciences, Kuybyshev

[Abstract] Closed shells of ferromagnetic material are used to make magnetic shields for measuring instruments and other small objects. The efficiency of the shielding depends to a great extent on geometric shape. The author analyzes the effectiveness of shielding in the shape of prolate and oblate spheroids in inhomogeneous and homogeneous magnetic fields. Multilayer shielding is also considered. Relations are derived for the principal structural parameters of shields and the required permeability, so that the material can be selected from the predetermined shielding factor. Figures 3; references: 6 Russian.

[132-6610]

USSR UDC 621.3.004.3.001.24

CALCULATING INDUCTORS FOR HEATING FERROMAGNETIC CYLINDRICAL BODIES

Moscow ELEKTRICHESTVO, No 1, Jan 80, pp 39-42 manuscript received 25 Sep 79

PAVLOV, N.A., candidate in technical sciences, Leningrad Electrical Engineering Institute imeni V.I. Ul'yanov (Lenin)

[Abstract] A means is presented for calculating the electric resistances of solid and hollow cylinders of ferromagnetic material in a one-dimensional electromagnetic field, in which the vector of the magnetic field strength is directed along the axis of the cylinder and the vector of the current density in the direction of the polar coordinate φ. Curves are shown which reflect the substantial effect of the ferromagnetic properties of the material on the magnitude of the resistances of the cylinder and the form of their dependence on the degree of manifestation of the surface effect. Only at very low frequencies of the field, when $R/\Delta_e \leq 0.9$, during calculation of the resistances, is it possible not to take into account the change of the magnetic permeability with respect to the radius of the cylinder. The generalized frequency characteristics of the resistances in a form suitable for practical use is obtained by a combination of analytical and numerical methods of solution. It should be noted that the method presented for calculation of the resistances of a ferromagnetic cylinder is not unique and calculation of the resistances can be done in other ways. Figures 3; references: 4 Russian.

[125-6415]

USSR UDC 621.313.13-181.4.001.3

A LINEAR INDUCTION MICROMOTOR WITH NONMAGNETIC SECONDARY ELEMENT

Moscow ELEKTRICHESTVO in Russian No 12, Dec 79 pp 47-49 manuscript received 27 Dec 77

VESELOVSKIY, S. N. and YEVLANOV, V. S., candidates in technical sciences, Novosibirsk

[Abstract] Linear induction motors used in tracking, oscillatory and other systems of automation with reciprocating motion of the working element have a secondary actuating component that is made in one unit with the working element. To keep inertia on a low level, the secondary element must be shorter than the inductor, and should be nonmagnetic to avoid attraction to the inductor. The authors propose a design for a micromotor of this type, and give some results of theoretical and experimental studies of this design. The secondary element is a nonmagnetic hollow cylinder. Expressions are given for the magnetic field strength, secondary current density, and electromagnetic force with single-phase and two-phase supply. It is shown how the length of the secondary element can be optimized to give the minimum electromagnetic force, thus eliminating the effect of self-action in automatic devices. Figures 4; references: 3 Russian.
[132-6610]

USSR UDC 621.313.13-752.001.24

INFLUENCE OF THE FLUID DIELECTRIC ON MAGNETIC VIBRATION OF AN IMMERSIBLE MOTOR

Moscow ELEKTRICHESTVO in Russian No 11, 1979 pp 75-78 manuscript received 16 Feb 79

LISAK, YE.I., Leningrad

[Abstract] Immersible motors employed in oil delivery systems in power equipment are characterized by the fact that their inside space is filled with a working fluid. When the stator vibrates on account of electromagnetic forces acting on it, the filling fluid exerts on the stator both an inertial and damping effect, and this effect itself is determined by the motion created in the fluid by the vibrating stator, i.e., on both the frequency and form of the stator's vibrations. An investigation is made here of the influence of the fluid on vibration characteristics. This study differs from previous ones in that the viscosity is taken into account in estimating its damping effect. Taken into account in addition is the axial flow of the

fluid, which can be comparable with the circumferential flow or even surpass it when the stator is not too long. For a theoretical analysis of the phenomenon the assumptions are made that the fluid is a viscous incompressible one, the stator is an elastic ring completing plane vibrations, the link between the stator and the base is not taken into account, and the stationary motion of the fluid caused by rotation of the rotor is disregarded. Equations are obtained for calculating the frequencies of free vibrations of the ring taking into account the apparent mass of the fluid. The main effect on the stator when it is vibrating is exerted by the layer of fluid in the space between the stator and the rotor, because its small thickness results in the creation of the greatest disturbances of velocities and pressure. The three-dimensional problem of hydrodynamics is discussed for a layer of viscous fluid whose rigid boundary completes a vibrational motion. It is demonstrated that the loss factor with vibrations in the fluid is proportional to the cube of the ratio of the radius of the layer of fluid to its thickness and to the cube of the ratio of the mean radius of the stator's back edge to its height. Damping is greater, the lower the order of magnitude of vibrations and the higher the frequency Calculations of the loss factor for a number of immersible machines, in addition to experimental studies, have demonstrated that filling with a viscous fluid such as oil results in quite considerable damping of the stator's vibrations. For an asynchronous motor with the parameters $a = 8$ cm, $h = 0.1$ cm, $L = 8.3$ cm, $v = 16 \cdot 10^{-2}$ cm^2/s, $p = 0.9 \cdot 10^{-3}$ kg/cm^3 and $r = 2$ at a frequency of 1520 Hz, the loss factor equals 0.276. Here a is the radius of the layer of fluid, h is the thickness of the fluid, L is the length of the stator, v is the kinematic viscosity of the fluid, p is the density of the fluid and r is the order of magnitude of the stator's vibrations. Figures 2; references: 7 Russian.
[91-8831]

USSR UDC 621.313.333.001.1

EQUATIONS OF THE DYNAMICS OF A MAGNETORESONANT SUSPENSION IN THE WORKING FIELD OF AN ELECTRIC MOTOR

Moscow ELEKTRICHESTVO in Russian No 12, Dec 79 pp 32-37 manuscript received 15 Jan 79

GALKIN, V. I., candidate in technical sciences, VNIIEM [probably All-Union Scientific-Research Institute of Electrical Machines]

[Abstract] One of the major problems of designing a magnetoresonant suspension is analysis of its operation under dynamic conditions. Previous studies of this question have covered the case of a magnetoresonant suspension in a pulsating magnetic field with a rotor that does not contain windings.

With operation in the working field of a motor, there is a rotating field and the rotor contains a winding for producing the required torque. Since rotor impedance depends on rate of turn, the regulating system for the suspension has variable parameters. A system of differential equations is derived for a magnetic suspension of this type. The calculations are done by the method of rotating vectors with consideration of both large and small rotor deflections. Regions of dynamic stability are plotted from the resultant equations. Analysis of these regions shows that stable suspension in the working field of a motor can be attained in all conditions from starting to free-running by appropriate selection of the damping factor and the rotor parameters. Figures 3; references: 8 Russian.
[132-6610]

USSR UDC 621.314.214.2.088

INFLUENCE OF LOAD ON THE PRECISION OF A FOUR-WINDING LINEAR ROTARY TRANSFORMER

Moscow ELEKTRICHESTVO in Russian No 12, Dec 79 pp 61-62 manuscript received 24 Jan 79

KHRUSHCHEV, V. V., doctor in technical sciences, and YUZVINKEVICH, V. V., candidate in technical sciences

[Abstract] The accuracy of linear rotary transformers is usually determined from measurements of the error of linear dependence of the output voltage as a function of the angle of turn of the rotor. These measurements are made during no-load operation. In practice, such transformers usually have a constant load resistance at the output that may be lower than the input impedance of the device when it is operating as a sine-cosine rotary transformer. To study the influence that the load has on the functional dependence of the secondary voltage as the rotor turns, the authors analyze a linear rotary transformer with primary symmetry. A comparison of results with experimental data shows satisfactory agreement. It is found that primary balancing is necessary when operating linear rotary transformers under a load, and when carrying out tests for accuracy classification in series production. Figures 2.
[132-6610]

USSR UDC 621.314.632.017.72

THERMAL CONDITIONS OF HIGH-VOLTAGE TRANSFORMER THYRISTORS WITH EVAPORATIVE COOLING

Moscow ELEKTRICHESTVO in Russian No 11, 1979 pp 61-63 manuscript received 27 Jun 77

IRAK, A.I., SAPIR, G.YA. and SPIRKA, V.M., candidates in technical sciences, Tallin

[Abstract] The problem is solved of determining the maximum temperature of the structure of a semiconductor power device in the example of the evaporative cooling with Freon-113 of the thyristors of a high-voltage transformer. The cooling system is a two-stage thermosiphon with a Freon and water vapor type of condenser. The thermosiphon is of the upright type, consisting of Duralumin evaporators with a channel diameter of 50 mm and measuring 100 X 66 mm with a height of 70 mm. A thyristor is fastened to either side of each evaporator and the condensate runs off down through a circulation tube; this makes it possible for the Freon to gas in a circular channel. It is assumed that the output current pulses of the transformer are trapezoidal with a pulse length of 1.2 s, an amplitude of 2500 A and a linear increase in current from zero to the maximum, and that decay takes place in 0.2 s. The length of a cycle is 2.2 s. These current pulse characteristics match those of a power pulse with a peak value of 400 W. The mean current of one of the transformer's thyristors is assumed to equal 140 A, which is in accord with the thermal losses of a type TD2-500 thyristor, equaling 213 W. Taken into account is the fact that there is some nonuniformity in the distribution of current between thyristors connected in a three-phase bridge with two parallel thyristors in each arm. An equivalent circuit is presented for a numerical calculation of the temperatures of a thyristor and of its cooling system. A calculation is made for a TD2-500 thyristor fastened to the evaporator at the cathode end. The thermosiphon contained a total of 28 thyristors. The results of an experiment showing the dependence of the maximum temperature of the semiconductor structure of a semiconductor power device and of the case of the power device on the number of power pulses show that the temperature in the cooling system is stabilized 2 to 2.5 min after the thyristors are connected to the nominal current load. When the temperature of the water in the inlet of the condenser is dropped by 10 and 20°C, the maximum temperature of the structure is lowered by 9 and 18°C, respectively. The measured temperature of the case of an upper semiconductor power device with a water temperature of 30°C and a mean current of 140 A equaled 60.8°C. It is demonstrated that the calculated maximum temperature of a semiconductor power device structure is considerably higher than the mean value determined in relation to the power of losses characteristic of the mean current of the thyristor. The procedure suggested makes it possible to determine the temperature in all elements of the cooling system. Figures 3; references: 5 Russian. [91-8831]

USSR UDC 621.314.632.018.782.2.001.24

ANALYSIS OF POSTCOMMUTATION PROCESSES IN A HIGH-POWER HIGH-VOLTAGE SEMICONDUCTOR TRANSFORMER

Moscow ELEKTRICHESTVO in Russian No 11, 1979 pp 31-35 manuscript received 22 May 78

GRINSHTEYN, B.I., candidate in technical sciences, and ZHMUROV, V.P., engineer, ENIN (Institute of Power Engineering imeni G.M. Krzhizhanovskiy)

[Abstract] A major problem in the development of high-power high-voltage semiconductor transformers is ensuring the reliable operation of semiconductor rectifiers under steady-state and dynamic conditions. The calculated values of electrical effects applied to semiconductor rectifiers in specific transformer circuits over their entire operating range must not exceed specified tolerance values. For ensuring the normal operation of series-connected thyristors in the postcommutation period, RC circuits or opposing series-connected avalanche diodes, or a combination of these two methods are used. For the purpose of generalization, an equivalent calculation circuit for a transformer arm is presented, whose structure and parameters cover all the key features of high-voltage transformer circuits. Here it is necessary to take into account the stray capacitances of equipment, making it necessary to employ damping circuits which cut off commutation overvoltages. A high-frequency reactor is usually used to protect the thyristors of the transformer bridge from the effect of pulsed overvoltages, as well as an additional damping circuit, and a saturation choke is used to protect the thyristors from the discharge of the stray capacitance through them when they are connected. In drawing an equivalent circuit for the purpose of calculating postcommutation processes in semiconductor rectifiers of a transformer bridge, it is necessary to construct a physical and mathematical model of the circuit of series-connected transistors which will take into account the nonsimultaneity of restoration of their cutoff capacity. For this purpose the thyristors are replaced by instantaneous-operation switches which open at specific times corresponding to the instants of restoration of the cutoff capacities of the thyristors. For a linear distribution of the restoration charge in a circuit of series-connected thyristors, the instants are found for the restoration of cutoff capacity. An equivalent circuit is presented for calculating the postcommutation process in a high-voltage transformer. Discussed in detail are processes in the circuit for the variant employing thyristors shunted by RC circuits and when the thyristors are shunted by opposed series-connected avalanche diodes. The equations derived are solved for a linear distribution of restoration times for the cutoff capacity of 140 type TZ-320 thyristors with a minimum time of 10 us and a maximum time of 30 us with a commutation current drop rate of 3 A/us. It is shown that an increase in the total time for restoration of the cutoff capcity of a circuit of thyristors taking place in the postcommutation period in high-voltage transformer circuits results in an increase in the time for restoration of the control capacity of the thyristors. This phenomenon is decisive

when the transformer is operating in the inverter mode, where it determines the commutation stability of the inverter. For high-voltage transformers operating in the rectification mode, it is preferable to protect the thyristors with avalanche diodes, and for those operating in the inverter mode, the combined method of protecting thyristors is preferable in order to improve commutation stability. It is necessary to take into account the actual time for the restoration of the control capacity of thyristors in developing a control system for high-voltage transformers. Forward-polarity overvoltages can have an effect on the transformer arm in these transformers, resulting in the fact that all thryistors will not recover their control capacity. Figures 6; references 5: 2 Russian; 3 Western.
[91-8831]

USSR UDC 621.316.542.064.241 027.3.064.42.001.57

CHARACTERISTICS OF THE BREAK ARC IN GAS CIRCUIT BREAKERS

Moscow ELEKTRICHESTVO in Russian No 11, 1979 pp 70-71 manuscript received 16 Apr 79

BORODYANSKIY, G.YA., BUYANTUYEV, S.L., KAPLAN, G.S. and KUKEKOV, G.A., Leningrad

[Abstract] Characteristics of break arcs are obtained, which can be used in designing, testing and modeling arc blowout chambers of high-voltage a.c. circuit breakers. A certain amount of heat energy is accumulated in the arc gap by the instant of zero current, and the magnitude of this heat energy is determined by the characteristics of the arc at the peak of the current. The results are given here of a theoretical and experimental investigation of the most important of these characteristics, viz., the voltage-versus-current and voltage-versus-flowrate characteristics. Characteristic of break arcs are high currents on the order of a few dozen kiloamps, a high rate of flow of gas blowing around the arc, and short gaps between contacts, with a maximum of 3 to 5 cm. These features have both a quantitative and qualitative effect on the characteristics of an arc discharge. Curves are shown of the radial distribution of enthalpy in terms of the length of the arc gap of an arc blowout chamber, illustrating a temperature profile which is essentially asymptotic. With an increase in the length of the arc blowout chamber the cooling effect of the stream of gas heated by the arc is lessened and the heat conduction mechanism for dissipation of the arc's energy is intensified. The gap between contacts in the arc blowout chamber of a gas-blast breaker is the area of the arc's development, where formation of the arc's profile takes place and its temperature range is determined. These features are reflected in the integral characteristics of the arc discharge, in particular, in the magnitude of the voltage in the arc and in

its dependence on the current and flowrate of the gas. In the calculations it is assumed that the decisive process for heat exchange in the arc blowout chamber of a gas-blast breaker at peak current is forced convection, as distinct from the thermal processes near the current zero, which are determined chiefly by heat conduction. Equations are obtained which represent the influence on the arc's voltage of a great number of variables, including the radius and length of the arc gap, the pressure of the gas in the chamber and the physical properties of the arc blowout medium. The results are given of experiments conducted in the electrical apparatus laboratory at Leningrad Polytechnical Institute imeni M.I. Kalinin, which made it possible to determine the magnitude of voltage in the arc at peak current as a function of the pressure of the gas in the chamber for different peak values of the broken current. These data are employed to determine a parameter reflecting the influence of temperature distributions over the space of the arc gap. Curves are arrived at which make it possible to make an estimated forecast of the amount of voltage in the arc under different conditions of operation of the arc blowout chamber, such as when varying the radius of the jet, the length of the arc gap and the pressure of the gas in the chamber. Figures 3; references: 3 Russian.
[91-8831]

USSR UDC 621.3.083.8:621.314.2

PRECISION OF INDUCTIVE ANGLE MEASURING ELEMENT IN A DOUBLE VOLTAGE CONVERSION CIRCUIT

Moscow ELEKTRICHESTVO, No 1, Jan 80, pp 62-66 manuscript received 12 Mar 79

LAKHOV, A.V. and LEVKOVICH, M.I. Moscow

[Abstract] An analysis is made of the operation of a linear inductive angle measuring element [datchik] (ID) in a circuit with conversion of input and output voltages. The wiring diagram is presented of such an ID, assembled on the basis of a minimum number of units. The circuit contains a generator of sinusoidal form oscillations (frequency 10-60 kHz), a phase-sensitive demodulator and a filteramplifier. Use of the ID considerably simplifies the circuit of the phase-sensitive detector, which does not require a standard voltage. The generator operates from a -15 V d-c source and is constructed on the base of one operational amplifier. It is shown that during operation of a linear inductive angle measuring element in a double voltage conversion circuit, an error in linearity corresponding to a change of the output signal of the circuit in the case of a change of the ambient temperature, is inversely proportional to the square of the Q-factor of the winding of the element [datchik] and directly proportional to the algebraic sum of the relative values of the change of resistances and capacitances of the capacitors of the demodulator. The eccentricity and ellipticity of the rotor and stator of the element cause an angular error which in new construction with an | - shaped rotor is considerably smaller than in type "Mikrosin" construction. Figures 3; references: 4 Russian.
[125-6415]

USSR UDC 621.372.001.24

ASPECTS OF THE EXCITATION OF SUBHARMONIC OSCILLATIONS IN MULTILOOP ALTERNATING CURRENT FERRORESONANT CIRCUITS

Moscow ELEKTRICHESTVO in Russian No 11, 1979 pp 20-25 manuscript received 24 Jan 79

KARIMOV, A.S. and TURDYYEV, M.T., Tashkent Polytechnical Institute

[Abstract] The basic rules for the conditions for the excitation of subharmonic oscillations in circuits with varying parameters have been studied sufficiently fully for systems with a single nonlinear element, but when there

are two or more nonlinear elements the search for regions of stable excitation of lower-harmonic oscillations becomes quite complicated because of the increase in the order of differential equations for circuit equilibria and because of the absence of efficient methods for solving them. When these oscillations are separated from the spectrum of frequencies generated by the nonlinear elements of a frequency conversion circuit, the filtering elements complicate the circuit and lower the quality of the converted signal. The method of dividing frequency in circuits with nonlinear inductances and linear capacitances is based on an analysis of phase-frequency relationships which reveal the conditions for and properties of the irreversibility of ferromagnetic ferquency converters. Both ferromagnetic frequency multipliers and ferromagnetic frequency dividers are considered irreversible devices. The frequency multiplication mechanism is designed on the basis of the generation of upper harmonics by a nonlinear element in the circuit, whereas frequency division is based on the phenomenon of paramagnetic resonance at the required frequency. A nonlinear oscillatory circuit in the form of a nonlinear inductance and linear capacitance is desirable in the circuitry of a ferromagnetic multiplier, but not obligatory, whereas in the circuitry of a ferromagnetic divider this resonant circuit forms the basis of the frequency conversion mechanism. This explains why it is not possible to use the same circuit both for frequency division and for frequency multiplication by simply rearranging the input and output terminals. A demonstration is given here of the fact that if autoparametric processes for energy conversion form the basis for frequency conversion, both upward and downward, the respective circuits become reversible. Reversible processes are analyzed on the basis of the classical circuit of Joly and Epstein, which is used for frequency multiplication by a factor of two. This circuit can be used for division of frequency by two, and an analysis is made here of how this is possible. A demonstration is given of the fact that under conditions of the excitation of autoparametric oscillations the circuit of this ferromagnetic frequency converter is reversible. Discussed as another example is the inverse operating mode of a three-phase one-phase frequency tripler employing the Spinelli circuit. The behavior of this circuit is discussed when it is connected in reverse, and it is shown how this behavior is altered if the circuit is employed in the mode of parametric excitation of oscillations at frequencies which are multiples of the frequency of the source when a nonlinear oscillatory circuit, a ferroresonance circuit, is created at the output. It is demonstrated that this circuit can be used for converting the frequency of a power supply, as an autoparametric system for generating multiphase subharmonic oscillations at frequencies of $w/2$, $w/3$, and $w/5$. This circuit can be used as a frequency divider with an m-phase output, which is demonstrated by an analysis of phase relationships by employing the method of harmonic balance. An experimental study was made of the Spinelli circuit in the inverse mode for the excitation of autoparametric oscillations at a frequency of $w/3$. The excitation of autoparametric oscillations as calculated and as illustrated by the experiment show good agreement. Figures 3; references: 6 Russian. [91-8831]

USSR UDC 62-83.001.1

ELECTRICAL DRIVES: PRESENT STATUS AND FUTURE OUTLOOK

Moscow ELEKTROTEKHNIKA in Russian, No 1, Jan 80 pp 33-36 manuscript received 18 Oct 79

YUN'KOV, M.G., candidate in technical sciences, director of the All-Union Scientific Research Institute of Electrical Drives (VNII elektroprivod)

[Abstract] Modern automated electrical drives include, in addition to d.c. and a.c. machines, power semiconductors and microelectronic devices as well as control computers. They are used in ferrous and nonferrous metallurgy, in mining, in the oil industry and in various other chemical industries, as well as in agriculture. Their development is based on scientific-technical as well as production and management research, mainly in theory and application of automatic control. This research has produced thyristor controls for up to 20,000 kW d.c. and 30,000 kW a.c. drives, transistor controls for up to 250 kW dynamically stable d.c. and a.c. drives, standard contactless devices for power transfer, microcomputer-aided direct digital control, microcomputer-aided plant control, programmed logic systems, also a highly mechanized and highly automated technology of motor, converter and controls manufacture. The major trend, based on both technical and economic indicators, is a steady shift from d.c. to a.c. machines, either by replacement or by new design which must include appropriate means of regulation. This trend affects both the manufacturing industry and the users, especially in the two areas of serially produced 10-500 kW drives and individually built up to 100,000 kW drives. This trend is reflected in scientific research on frequency conversion and development of new electromechanical devices such as linear and stepper motors as well as new semiconductor devices, in engineering research on handling of reactive power, designing of discrete control, equipment cooling and protection, and in technoeconomic research on reliability, efficiency and applications. Tables 1.
[148-2415]

USSR UDC 621.313.001.2

DEVELOPING STANDARD SERIES OF ELECTRICAL MACHINES - TECHNICAL POLICY OF THE ELECTRICAL ENGINEERING INDUSTRY IN THE SOVIET UNION

Moscow ELEKTROTEKHNIKA in Russian, No 1, Jan 80 pp 29-32 manuscript received 18 Oct 79

RADIN, V.I., doctor in technical sciences, KUZNETSOV, B.I., doctor in technical sciences, and SOROKER, T.G., doctor in technical sciences

[Abstract] Standardization of electrical machines produced in the Soviet Union began immediately after the Second World War, the series A-AO of 0.6-100 kW induction motors being the first one developed during the 1946-49 period. Production industry-wide was completely converted to this series by 1951 and, at the same time, all pertinent engineering documents were forwarded to the respective industries in Poland, Bulgaria, Romania and the People's Republic of China to facilitate their standardization of induction motors. The scientists-engineers B.I. KUZNETSOV. I.N. CHARAKHCH'YAN and M.I. ZEMLYANOY were responsible for this achievement. It was followed by development of standard 100-500 kW induction motors at the Baranchinskiy plant under the direction of Z.D. KRAVCHIK. At the same time, a standard series of 500-1000 kW induction motors and one of larger than 1000 kW alternators had been developed at the Leningrad plant by the end of the nineteen fifties. Independently there was developed the KzEMZ series of larger than 200 kW direct-current motors, with a rigid scale of power ratings at a fixed rpm level. In the nineteen sixties there was developed the second series A2-AO2 of 100 kW and smaller induction motors, with an average 25 percent saving in materials and an average 1.7 percent improvement in efficiency over the A-AO series. Other series of large induction motors and alternators were also developed during that decade, series D for export and series A3 with the first USSR State High-Quality Label. There followed a radical redesign to series 4A for another round of materials saving and efficiency improvement along with better manufacturability. A program (INTERELEKTRO) of producing an international series AI of induction motors with complete controls is underway, directed by the Joint Engineering-Technological Office at the Joint Scientific and Technical Council. In the meantime, since 1976 the All-Union Scientific Research Planning-Design and Technological Institute of Electrical Machines (VNIPTIEM) has monitored the applications and use of induction motors throughout the national economy. The experience gained so far serves as a guide for further improvements and standardization, especially in view of the current energy and materials crisis. An important concern also is noise reduction, by found proofing of machine components, by proper matching of the numbers of stator and rotor teeth, and by "fanless" cooling. One interesting new trend is replacement of cast iron with aluminum for motor frames. These features are being incorporated in the AI motor series. References: 13 Russian.
[148-2415]

USSR UDC 621.315.2/4.001.1

ACHIEVEMENTS AND MAIN DEVELOPMENT TRENDS IN THE CABLE INDUSTRY

Moscow ELEKTROTEKHNIKA in Russian, No 1, Jan 80 pp 38-42 manuscript received 5 Oct 79

PESHKOV, I.B., doctor in technical sciences, director of the All-Union Scientific Research Planning-Design and Technological Institute of the Cable Industry (VNIIKP)

[Abstract] Two major innovations in power cables are the use of superconducting materials, specifically niobium-titanium and niobium-tin alloys, and the use of polymers modified by radiation treatment for insulation. Cables are built for operation not only underground, where the flexible construction is preferable to a rigid one, but also for operation underwater as well as in outer space. Radiation treatment is done in special electron accelerators and has already produced such materials as nonflammable polyolefin composites and enamel varnishes with polyether cyanurimide which have at least 10,000 h life at temperatures up to 200°C. Also a high-voltage (2300 V) Teflon insulation has been developed for oil-pump motors. Other features include steel armor and corrugated aluminum shells as well as various high-voltage insulation materials based on polyethylene or paper. Innovations in communication cables are flexible elliptical waveguides and fiber optics. Improvements in conventional cables include coaxial designs for multiplexing over a wide frequency range, reduction of cabel diameter, use of hydrophobic fillers for better reliability and replacement of copper with bimetal (aluminum-copper) as conductor material. All progress in the cable industry is made possible by application of better and new technologies, more efficient manufacturing techniques in such areas as winding and welding, with either full or semiautomation. Another important spinoff of this progress, in addition to better performance and broader applications, is saving of energy and materials. Figures 2; tables 1.
[148-2415]

USSR UDC 621.316.001.1

TASKS IN THE FURTHER DEVELOPMENT OF LOW-VOLTAGE EQUIPMENT MANUFACTURE

Moscow ELEKTROTEKHNIKA in Russian, No 1, Jan 80 pp 36-38

MITSKEVICH, G.F., candidate in technical sciences, director of the All-Union Scientific Research Institute of Electrical Equipment (VNIIelektroapparat)

[Abstract] Low-voltage equipment produced by the domestic electrical industry over the 1972-77 period includes disconnect switches and protective devices with current ratings up to 100 A and 160-630 A. Current-limiting and current-selecting switches, based on physically opposite design principles, have been almost completely standardized in terms of component parts. Low-voltage control equipment includes a standard general-purpose series rated for currents up to 630 A and voltages up to 660 V. In order to meet the demand throughout the national economy for the next 10 years, it has been found necessary to optimize the performance parameters of equipment in relation to requirements by present as well as future users. This in turn requires scientific research and experimental design efforts aimed at optimization of technology, replacement of copper and silver, improvement of existing and development of new materials, weight and size reduction, reduction of manual labor and energy consumption in the manufacturing process, and improvement of reliability in special applications. There is also a need for mathematical models and computerization of the design effort as well as for further exploration of physical laws and extension of theories, also for innovative design methods. As a result, there are foreseen integrated new integrated control-regulation-protection systems, contactless power semi-conductor devices and contacts with arc quenching in vacuum. Logic elements based on hermetically sealed "Gersikon" contacts will eliminate intermediate elements such as thyristors, diodes, capacitors and relays. These devices are already rated for 6.3 A and can be used for controlling up to 1 [illegible] kW large induction motors. Tables 2.
[148-2415]

USSR UDC 621.382.001.1

MANUFACTURE OF POWER SEMICONDUCTOR DEVICES

Moscow ELEKTROTEKHNIKA in Russian, No 1, Jan 80 pp 42-47

TUCHKEVICH, V.M., academician, USSR Academy of Sciences, TEPMAN, I.A., candidate in technical sciences, KOVALEV, F.I., candidate in technical sciences, and YAKIVCHIK, N.I., candidate in technical sciences

[Abstract] Production of power semiconductor devices in the Soviet Union has increased more than sixfold during the last 10 years, reaching a volume of tens of millions of units worth hundreds of millions of rubles. While thyristors for converting equipment are particularly affected by this expansion, there is also an overall trend toward greater diversification, higher ratings, and better quality. Research and development proceeds in several directions, with emphasis on multilayer silicon structures, A^3-B^5 semiconductor materials and high-speed heterojunctions (GaAs, SiC), large-area high-power silicon devices, nonuniform physical phenomena and electrical as well as thermal transients. The second generation of power semiconductor devices is already almost completely developed, on the basis of a standard series encompassing a multitude of types with various ratings. They include symmetric, high-speed, avalanche and optronic thyristor diodes as well as power transistors. New technologies necessary to produce these devices include impurity diffusion from doped films, spray deposition of thick-film resistive contacts, acidic jet etching, formation of electron-ion plasma by laser or microwave irradiation or impact waves, formation of large-area multilayer structures by ion implantation, plasmochemical treatment or local epitaxy, control of the electrophysical properties of silicon by neutron doping, electron bombardment or gamma irradiation. Figures 6; tables 4.
[148-2415]

USSR UDC [669.15'71+546.28].001.4

INVESTIGATION OF THE MAGNETIC PROPERTIES OF Fe-Si-Al ALLOYS IN THE HIGH-FREQUENCY REGION

Moscow ELEKTRICHESTVO in Russian No 12, Dec 79 pp 50-52 manuscript received 28 Oct 78

DRUZHININ, V. V. (Sverdlovsk), MIRONOV, L. V., BULYCHEVA, Z. N. (Moscow), candidates in technical sciences; MINTS, B. B. (Sverdlovsk) and SVEZHOVA, S. I. (Moscow), engineers

[Abstract] The electromagnetic properties of Fe-Si-Al alloys are studied in the frequency region from 400 to 10^4 Hz. For purposes of proper selection

of alloy composition and production technique, it is necessary to study the influence that resistivity has on magnetic losses for specimens of different thickness with fine-grained and coarse-grained structure, and also the way that coercive force depends on dopant content, because a reduction of coercive force in the high-frequency region can considerably reduce hysteresis losses, which are a high percentage of the total magnetic losses. Therefore specific losses were measured with determination of coercive force, resistivity and grain size. It was found that magnetic losses decrease linearly with increasing resistivity of the alloys at frequencies of 1-10 kHz, and the slope of the dependence increases with the thickness of the sheet specimen. An increase in the resistivity of the alloy reduces the influence that grain size has on magnetic losses in the range of 1-10 kHz. Magnetic losses increase more rapidly with increasing magnetic induction for specimens with high resistivity. Magnetic losses decrease in proportion to decreasing thickness of the sheet specimen. Figures 3; tables 6; references 7: 6 Russian; 1 Western.
[132-6610]

USSR UDC 621.91

FUNCTIONAL DISPLAY FOR REPRESENTATION OF A THREE-DIMENSIONAL PICTURE OF OIL WELLS

Leningrad IZVUZ: PRIBOROSTROYENIYE in Russian Vol 22 No 9, Sep 79 pp 74-77 manuscript received 14 Nov 78

MAMEDOV, F.S., Azerbaydzhan Institute of Petroleum and Chemistry imeni M. Azizbekov

[Abstract] A description is given of a display which has been developed for presenting a three-dimensional picture of an oil well and is distinguished by its use of the functional method of forming an image on the screen of a CRT (cathode ray tube). In the functional method, as distinct from the raster method, symbols are represented by the simultaneous formation of a system of three voltages of special form, under the influence of two of which the beam traces successively the symbols represented, while the third controls the CRT's brightness. The display is used in profilometry for representing a profile of the cross section of the well in the form of continuous closed curves over a specific range of depth with a three-dimensional orientation, with a reference to the depth and curvature of the well and the magnetic meridian. Continuous measurements are made of 16 radius vectors of the well along its shaft so that at any depth the well's cross section is described by 16 discrete readings. The profile is restored from discrete readings by employing an interpolator filter consisting of a step interpolator and a Butterworth second-order low-frequency filter. Along with the profile represented on the screen is shown the depth of the cross section and additional auxiliary information. A single picture is formed during period of time $T_n = T_t + T_p + T_{s1} + T_{s2} + T_g$, representing the sum of the times for tracing points and the profile and displaying two pieces of auxiliary information and the depth, respectively. During time T_t [points] a null signal is fed to the CRT's deflection plates. During time T_p [profile] are fed two sinusoidal voltages of identical frequency and phase-shifted by 90° relative to one another, where the amplitude of oscillations is modulated by a signal characterizing the well's cross section. During time T_g [depth] two trapezoidal voltages are supplied for the purpose of forming a four-place number representing the depth, from 0 to 9999, and consisting of a seven-segment matrix. The auxiliary information can be in the form of two circles representing the diameters of the casing string and bit with which the well is drilled, or digits representing the well's azimuth of deviation and dip. It takes 2.5 ms to trace each symbol, so that T_n = 20 ms. A block diagram of the display is shown and the operation of its components is described in detail. The display receives output signals from a 16-channel profilometer, which after unification and scaling enter the display in the form of a 0 to 5 V d.c. voltage. This voltage is fed to the switch input of a commutator which controls a clock-controlled ring

register. At the commutator's output is received a step-interpolated signal characterizing the profile of the well's cross section. The diameter of the casing string is represented by a dotted line to make it easier to isolate the information displayed. When the modulators and interpolating filter are carefully tuned, the error in restoring the profile from discrete readings equals two percent. The display can be used in solving many other problems in which it is necessary to create and display closed curves from a limited number of reading points. The paper was recommended by the Department of Measuring and Computing Techniques. Figures 1; references: 3 Russian.
[103-8831]

Optoelectronics, Quasi-Optical Devices

USSR UDC 535.317.2

INFLUENCE OF NONUNIFORMITY OF THE SOURCE'S BRIGHTNESS ON THE POSITION OF THE OPTICAL EQUAL-SIGNAL ZONE

Leningrad IZVIVUZ: PRIBOROSTROYENIYE in Russian Vol 22 No 9, Sep 79 pp 86-91 manuscript received 16 Oct 78

TIMOFEYEV, A.N., Leningrad Institute of Precision Mechanics and Optics

[Abstract] Optoelectronic devices for three-point monitoring of rectilinearity employ as a measurement basis an optical equal-signal zone (ORZ). This zone is defined as the region of intersection of two or more electromagnetic fields in the optical bank in which the values of the dominant information parameter are equal. In the majority of optoelectronics devices this information parameter is the illumination intensity. In order to ensure stability of the optical equal-signal zone's position, it is necessary that the illumination intensity's spatial distribution be kept constant. Real radiating elements have nonuniform brightness, which results in distortion of the spatial distribution of illumination intensity and therefore in deviation of the optical equal-signal zone's position from the calculated. A study is made here of the influence of nonuniformity of the brightness of the radiation source on the position of the optical equal-signal zone. Optoelectronic devices utilizing this method consists of three parts: a light source, an information section forming the optical equal-signal zone in the cross section of the light source's beam, and a receiving section which converts the optical signal into an electrical. A model is created of the optoelectronic device's optical system, where the light source is represented by an exit pupil, the receiving section by an entrance pupil, and between them is placed a modulator consisting of two halves in which transmission changes in time from zero to one strictly in opposition. The case is considered when an image of the radiation source is projected onto the exit pupil of the light source, while the exit pupil of a condenser system is focused at a finite distance. Any nonuniformity in the brightness of the radiation source in terms of area is represented by the sum of the harmonics of brightness components. An estimate is made of the influence of nonuniformity in brightness of the type $B(x) = B_0 + B_1 \cos (2\ \ /\ \ )(x -\ \ x)$, where B_0 is the mean overall brightness of the radiating area, B_1 is the range of variation of brightness over the radiating area and x is the initial phase of the variable component of the illumination intensity. The optical equal-signal zone is thus the geometrical area of points in which the illumination intensity created by the light source through one half of the modulator is equal to that created through the other half. An equation is derived from which is is possible to find the amount of displacement of the optical equal-signal zone. Computer computations made it possible to find the dependence of the maximum displacement of the optical equal-signal

zone on the ratio of the size of the pupil to the length of the period (spacing) of the nonuniformity with fixed values of the ratio of the variable component of the illumination intensity to the mean overall brightness. It is demonstrated that with a pupil size equal to an even number of periods of the variable brightness component displacement of the optical equal-signal zone does not take place. This is true of a square exit pupil; it is demonstrated that for a round exit pupil there is no position at which the maximum value of the displacement of this zone will equal zero. Equations are given for the distribution of brightness in motion picture projector lamps and aircraft incandescent lamps and in light-emitting diodes. It is demonstrated that the maximum displacement of the optical equal-signal zone can be considerable and that it is therefore necessary to take into account the influence of the nonuniformity of the brightness of the radiation source. The paper was recommended by the Department (Kafedra) of Optoelectronic Devices. Figures 3; references: 5 Russian
[103-8831]

USSR UDC 621.373.5

SQUARE VOLTAGE PULSE GENERATOR

Leningrad IZVIVUZ: PRIBOROSTROYENIYE in Russian Vol 22 No 9, Sep 79 pp 78-81 manuscript received 25 Jan 79

GRIGOR'YEV, B.I. and GRUZDEV, V.I., Leningrad Institute of Precision Mechanics and Optics

[Abstract] A description is given of a generator which forms square positive voltage pulses with an amplitude of up to a few thousand volts and a length of up to a few hundred microseconds with a pulse rise and fall time no longer than 0.1 us. The pulse repetition rate is from fractions of a hertz to 10 kHz, whereby the upper frequency limit is determined by the cutoff time of a dynistor, which can reach 80 us at +70°C. The generator's circuitry includes a driver stage designed on the basis of a dynistor, control circuits with transistors as active elements, and an output stage designed on the basis of a choke type of current source. Current and voltage diagrams explaining the generator's operation are given, along with a circuit diagram. The circuitry of this generator makes it possible to overcome the disadvantages of similar units in terms of their relatively low output voltage amplitude and the interrelationship between the pulse's length and fronts. It has been demonstrated by experimental studies that with a change in temperature of the environment from +10 to +70°C the length of output pulses can be reduced and their repetition rate can increase by approximately five percent. The stability of the length and repetition rate of this generator's output pulses is sufficiently high with slight fluctuations in temperature. This stability is governed solely by the temperature dependence of the breakdown voltage of two dynistors. A loop consisting of a resistor and a KS168A stabilitron makes it possible to increase the length of the output pulse to a few hundred microseconds. The choke-type current source includes an approximately-80-V voltage source, a choke, and a 6P45S tetrode. The functional capabilities along with a mathematical analysis and the physical processes taking place in this type of current source are presented in earlier studies (1974 and 1975). It is the choke-type current source employed in this generator's circuitry which makes it possible to form output voltage pulses with an amplitude as high as a few thousand volts and a power of a few thousand watts. This square voltage pulse generator has been used in a number of pieces of measuring equipment utilizing high-power flash tubes, such as in an instrument for monitoring the electrophysical parameters of semiconductor diodes and thyristors, as well as in the creation of an experimental unit for determining the transient heat resistance of an electronic device employing a posistor in its protection circuit. The paper was recommended by the Department (Kafedra) of Electrical Engineering. Figures 2; references: 3 Russian.
[103-8831]

Power Systems [including effect of various items on power transmission lines]

USSR UDC 538.311.001.24

SCREENING EFFECT OF CONDUCTOR SHEATHS CONNECTED ELECTRICALLY TO A CONDUCTING CASING

Moscow ELEKTRICHESTVO, No 1, Jan 80, pp 42-46 manuscript received 28 Dec 78

TSITSIKYAN, G.N., IGNAT'YEV, V.I. and MERKUR'YEV, V.G. Leningrad

[Abstract] For an analysis of the screening effect of conductor sheaths connected electrically at two or more points to a conducting casing, a line is considered in which a current flows at some distance from the plane surface of a solid conducting massive wall of arbitrary thickness, and a magnetic permeability which in the general case differs from μ_0. The wall plays the role of a casing or the earth. The eddy currents and magnetization in the wall are taken into account. A quantitative evaluation is made of the degree of weakening of the quasi-stationary magnetic field and the induced voltages in the surrounding space. Figures 3; references 8: 3 Russian; 5 Western.
[125-6415]

USSR UDC 621.31.004.1(479.25)(23.0)

OPERATING EXPERIENCE WITH STANDARD ELECTRICAL EQUIPMENT IN THE ARMENIAN MAIN POWER SUPPLY SYSTEM UNDER HIGH-ALTITUDE MOUNTAINOUS CONDITIONS

Moscow ELEKTROTEKHNIKA in Russian, No 1, Jan 80 pp 57-58 manuscript received 4 Sep 79

ASHIKYAN, N.M., engineer, and TOROSYAN, M.T., engineer

[Abstract] More than 80 percent of all 35-330 kV substations and transmission lines in the Armenian electric power system are located at altitudes higher than 1000 m, up to 3200 m above the sea level, 19.5 percent within the 940-980 m range of altitudes and 0.5 percent within the 800-960 m range of altitudes. The high-altitude equipment includes 220 kV 125-250 MVA, 110 kV 6.3-63 MVA, 35 kV 0.56-3.2 MVA power transformers, 330/242/110 kV 240 MVA autotransformers, potential and current transformers, low voltage circuit breakers and dischargers. Both Soviet-made and ASEA (Swedish) equipment is installed here. Most of it is in service since 1948, some has been added in 1975. Successful operation is probably attributable to an adequate margin of electrical strength in the outer insulation and to the high electrical resistivity of rain water. Some equipment operates in an atmosphere polluted by industrial waste from chemical manufacturing plants and state regional electric power stations located within the 1400-1700 m zone. Neither dust

nor moisture seem to have an adverse effect on the normal operation of this electrical equipment. Evidently the electrical strength of the outer insulation does not suffer because of the low air density at such altitudes above the sea level. On the basis of practical experience as well as of scientific research, therefore, standard 35-110 kV equipment can be recommended for installation at altitudes up to 2000 m above the sea level. Further studies are needed before recommending higher than 110 kV equipment for installation at such altitudes. Tables 1; references: 3 Russian.
[148-2415]

USSR UDC 621.311.8.018.782.3.001.57

INVESTIGATION OF TRANSIENT PROCESSES IN GUARANTEED-POWER-SUPPLY SYSTEMS

Moscow ELEKTRICHESTVO in Russian No 11, 1979 pp 46-49 manuscript received 10 Apr 79

CHERNOVETS, A.K., SHARGIN, YU.M. and TUZHIK, R.G.

[Abstract] Systems for a guaranteed high-capacity electric power supply which tolerate considerable reductions in frequency and absolute value of the supply voltage are usually made with flywheels rigidly connected to the shaft of a synchronous generator and to diesel generators which are automatically started during idling, with friction or overrunning clutches. Two variants of such a system are shown, one in which consumers receive power from a generator in the normal mode, and another in which they receive power from an outside line. The second variant is of interest from the viewpoint of supplying electric power to the main circulating pumps of nuclear power reactors under emergency idling conditions if it is undesirable or impossible to install a flywheel on the shaft of a main circulating pump and the combined rundown of the motors of the main circulating pumps along with the main turbogenerator does not provide the required reliability, such as in monoblock arrangements for nuclear power plants. This variant has the additional advantage that it makes it possible to use the synchronous generator as a synchronous compensator for the delivery of peak power and to provide forced circulation after idling and rundown with an output governed by the capacity and ratio of the nominal r.p.m. of the diesel and its generator. A study is made of electromechanical transient processes in combined rundown of the generator with a flywheel and a major consumer load during the period of time required for starting the diesel and subsequent frequency-response startup of the independent system when the diesel reaches the r.p.m. of the system running down and the overrunning or friction clutch is engaged. The analysis is based on a calculation diagram of rundown changing into a frequency-response start. It is demonstrated that for the purpose of

maintaining the stability of the system both in rundown and in frequency-response startup it is best to connect the generator's excitation coil to an extraneous source, such as a storage battery or standby exciter with an independent power supply. Diagrams are given of the electromechanical transient process in the successful combined rundown and subsequent frequency-response startup of main circulating pumps from a 15D-100 diesel generator with the generator in the initial compensator mode with overexcitation, and of the initial section of the electromechanical transient process in combined rundown of a main circulating pump motor with a 15D-100 diesel generator with different reactive loads of the generator in the initial compensator mode and different values of the motor's inertial constant. To avoid a rapid drop in the voltage when the power is cut off from the system it is necessary that the generator's reactive power in the initial compensator mode match the reactive power required by the motors. It is demonstrated that in guaranteed-power-supply systems utilizing the energy of flywheels for the startup period of the diesel generator and subsequent frequency-response startup of the running down load a great difference in the inertial constants of the generator with the flywheel and of the motors results in disturbance of the stability of the asynchronous load during the initial period of joint rundown after the power is cut off from the system. When this stability is maintained during the initial period, its further disturbance does not take place, regardless of the inertial constant of the motor load and of excitation of the generator in the initial mode. Matching the reactive power of the generator and motors in the normal mode is sufficient to maintain stability of the motor load. When the system discussed is used to supply power to the main circulating pumps of nuclear power plants it is possible to refrain from placing flywheels directly on the shafts of main circulating pumps for the purpose of emergency cooling of the reactor, resulting in simplicity of design and improved reliability and safety. Figures 3; references: 6 Russian.
[91-8831]

USSR UDC 621.316.1.014.38.001.24

ON THE PROBABILITY AND STATISTICAL CHARACTERISTICS FOR SHORT CIRCUIT CURRENTS IN POWER SUPPLY SYSTEMS

Moscow ELEKTRICHESTVO, No 1, Jan 80, pp 5-11 manuscript received 1 Jun 79

KAYN, M. (Berlin) and GLAZUNOV, A.A. (Moscow), candidate in technical sciences

[Abstract] The results are presented of an investigation of some basic probability-statistical characteristics of short circuits and the magnitude of the current flowing in the process. The following are studied: 1) General conditions for obtaining probability-statistical characteristics of short

circuits; 2) Probability-statistical characteristics of short circuit currents; 3) Probability approach for short circuits; 4) Forecasting the growth of short circuit currents; and 5) Construction of probability-statistical mathematical models of the calculated values of short circuit currents. The principal problems in optimizing their calculated values are formulated. The statistical characteristics are determined of the short circuit currents in the 380 V networks of large industrial enterprises. Figures 5; references 11: 8 East German.
[125-6415]

USSR UDC 621.316.933(23.0)

DEVELOPMENT OF DISCHARGERS FOR OPERATION IN HIGH-MOUNTAIN REGIONS

Moscow ELEKTROTEKHNIKA in Russian, No 1, Jan 80 pp 61-63 manuscript received 3 Oct 79

KARAPETYAN, M.M., candidate in technical sciences, and VARTAZARYAN, V.G., engineer

[Abstract] Operation of lightning arresters at high altitudes is adversely affected by the large pressure and by temperature and humidity gradients. Low pressure, particularly, reduces the electrical strength of the outer insulation, while the breakdown pulse voltage is the same in the mountains as in the plains. The most important feature of hermetically sealed high-altitude will be an internal pressure equal to the external pressure at the given location and a breakdown voltage level higher than that at the sea level in the inverse proportion to the respective air densities. In order to establish the feasibility of such a design, adaptation of standard arresters was studied and, as a result, a high-altitude version of the RVS-110 device for operation at 1000-2000 m altitudes above the sea level has been developed. The breakdown characteristics, under pulse voltages as well as under 50 Hz and higher-frequency voltages were measured in dry air and in rain. The arc-quenching characteristics were measured under the same sets of conditions and found to be almost unaffected by the low air pressure. Part of the study was conducted together with the A.C. Lightning Arresters Laboratory of the VEI (All-Union Order of Lenin and Order of the October Revolution Electrical Engineering Institute imeni V.I. Lenin) under the direction of V. V. Smatovich. Figures 1; tables 1; references: 2 Russian.
[148-2415]

USSR UDC 621.319.44.015.38.001.5

SWITCHING OVERVOLTAGES WHEN SWITCHING OFF LARGE CAPACITOR BANKS WITH PROTECTIVE DEVICES

Moscow ELEKTRICHESTVO in Russian No 11, 1979 pp 49-52 manuscript received 25 Sep 78

MIRONOV, G.A., DZHAFAROV, E.M., LAZIMOV, T.M. and PANASYUK, D.I.

[Abstract] Questions relating to the protection of large capacitor banks from overvoltages when they are switched are important in view of their wide use in power systems. In 1976-1977 the AZNIIE imeni I.G. Yes'mzn with the enterprise "Energotekhprom" of the USSR Ministry of Power and Electrification and Krasnedar Power developed and introduced Resistance Units for protecting 35 kV static capacitor banks with a capacity of 35 and 31.5 Mvar at 220/110/35 kV substations. The protective effect of these units is based on the fact that a bank's capacitors are shunted by resistors directly before the capacitors are switched off, as a result of which the phase shift between the voltage in the static capacitor bank and the switched off current is reduced, and the capacitors are discharged at a faster pace after they are switched off during the time that the polarity of the voltage on the part of the power supply is being changed. In developing these protective units studies were made by means of digital computers of switching overvoltages when large capacitor banks are switched off by means of different kinds of protective devices, and studies were also made of factors influencing overvoltages, such as, in particular, the conditions for grounding the capacitor bank's neutral wire. The results of some of these studies are presented. A mathematical model is given of processes taking place in the switching of capacitor banks. Discussed are the influence on overvoltages of conditions for grounding the neutral wire, switching overvoltages when static capacitor banks are switched off with preliminarily switched on shunting resistors, switching overvoltages when static capacitor banks are switched off with resonant switching of resistors, lowering of the recoverable voltage in the contacts of a circuit breaker by means of spark-gap connection of resistors on the static capacitor bank side, and the damping of overvoltages in repeated tripping in circuit breakers by means of nonlinear arresting devices for overvoltages. It is shown that grounding of the neutral wire does not reduce overvoltages resulting from repeated tripping in circuit breakers. When grounding resistors are connected to the neutral wire, the nature of the processes which take place is determined by the ratio of the bias of the potential of the neutral wire and the electric strength of the gap between the contacts of the circuit breaker. Grounding resistors in the neutral wire can reduce overvoltages during repeated tripping and voltages restored in the contacts of a circuit breaker within the range of 15 to 20 percent. Repeated arcing in circuit breakers can be

eliminated by preconnecting shunting resistors. An effective means of protecting from overvoltages in the switching of 110-kV-and-up capacitor banks is to connect the resistors by means of a spark gap at the capacitor bank and with a breakdown voltage of the spark gap of 1.6 to 1.9 times the phase voltage in combination with a protective spark gap arrester at the power supply end. When the shunting resistors are connected via a resonant circuit or inductance, it is necessary to take into account the possibility of an oscillatory process in discharging of the capacitor bank. Figures 3; references 8: 6 Russian; 2 Western.
[91-8831]

USSR UDC 621.3.044.3:538.311.001.24

INTERACTION OF A MAGNETIC PULSE FIELD WITH A "HALF SPACE" MOVING AT CONSTANT VELOCITY

Moscow ELEKTRICHESTVO, No 1, Jan 80, pp 66-68 manuscript received 13 Sep 78

KALIKHMAN, S.A., candidate in technical sciences, Chuvashskiy State University

[Abstract] In various areas of technology use is found for processes and devices which utilize acceleration of conductors in a magnetic pulse field. These devices are designed by methods of circuit theory on the basis of equivalent circuits, during which the equivalent parameters are usually determined for a stationary system. However, a complete analysis of the electromagnetic processes and the choice of the equivalent circuit can be produced only with the movement of a massive body taken into account. The present work studies an idealized one-dimensional model for calculation of the induction of a magnetic field in which a massive accelerated body represented by a "half space" element of unit area of cross section moves with constant velocity between current-conducting rails. A comparison of relations derived in the present work with expressions from the literature for penetration of a magnetic pulse filed in a stationary "half space" shows that movement leads to a decrease of the attenuation and the phase angle of vectors which characterize the electromagnetic field. Figures 2; references 4: 3 Russian; 1 Western (translated).
[125-6415]

USSR UDC 338.4(47):621.3

METHODOLOGICAL ASPECTS OF DETERMINING THE DEMAND FOR ELECTRICAL EQUIPMENT PRODUCTION

Moscow ELEKTROTEKHNIKA in Russian, No 1, Jan 80 pp 47-50 manuscript received 25 Jul 78

RUBVAL'TER, D.A., engineer

[Abstract] The problem of determining the demand for electrical equipment production is examined from a system standpoint, considering all factors which influence the projected demand level and thus the necessary planning. Internal factors include changes in the production design and in the production setup, external factors include national economic indicators and the rates of growth of individual customer groups. Accordingly, in the planning stage, the demand for production of electrical equipment is determined in two steps: first on the basis of projected energy generation and then on the basis of trends in the use of the equipment. Electrical equipment can be classified into a few basic functional categories, the principal three being generating equipment, transmission and distribution equipment, and terminal equipment, all three categories being interrelated and interdependent. A fourth category is regardless of function, equipment necessary for manufacturing a given product and a fifth category is communication equipment. In production planning for any branch of the electrical industry there must be included the own needs of a particular branch, approximately 16 percent of the entire industry-wide output now covering these internal needs. The entire output is made up of "pure" products made of other products but not used by the branch making them, products used as such or as material for other products, and "pure" materials. Each category plays its role in any production and distribution balance. The maximum output or the output to meet a given demand at the minimum cost can serve as the criterion for balancing. Such an approach to production planning has already been successfully taken by the chemical industry. Figures 1; references: 4 Russian. [148-2415]

- END -

END OF FICHE

DATE FILMED

25 April 1980

D.D.